Photos by Donald Dondero

A multimillionaire with a grade eight education, Bill Lear designed and built the Lear Jet (far left). As an answer to auto pollution (see cover) he built steam car (L). Tubing (below) is part of new steam boiler.

And now he is gambling $10 million to build the first smog-free auto engine. After he had stood the plane on its tail and soared to 41,000 feet at a climb rate of 9,000 feet a minute, he switched on the autopilot and came back for a chat.

"In my opinion, the internal combustion engine will never be satisfactory from a pollution standpoint," he said. "And the most undesirable emission is the one that is considered last — oxides of nitrogen."

Oxides of nitrogen are believed by some scientists to be the most dangerous of all air pollutants, many times worse than even carbon monoxide. And ironically, present controls accentuate the problem. By burning gasoline at higher temperatures to reduce the hydrocarbons and carbon monoxide in their exhaust fumes, current car engines increase their output of oxides of nitrogen — according to some tests, by more than 100 percent.

By 1974, California wants emissions of nitric oxides reduced to one-fourteenth of the levels emitted by some present cars. No one yet knows whether it is possible for the auto industry to achieve this reduction and some reports suggest that even if it can, engines will be twice their present price, though they will give poorer mileage and performance.

"The motor industry is trying to sweep oxides of nitrogen under the rug," said Lear. "They've even gone so far as to say it would be harmful to get rid of them."

Los Angeles-type smog occurs when sunlight acts on a certain critical mixture of hydrocarbons and

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Frank Prazak — Weekend Magazine

The world's top Grand Prix driver, Jackie Stewart, wanted to drive Lear's steam-powered racing car in the Indy 500

oxides of nitrogen suspended in the air. One Detroit theory is that if oxides of nitrogen were reduced at the same rate as hydrocarbons, the critical proportions would remain the same, and the smog might persist.

In view of all this, Lear decided in 1968 that there would be a good market for a steam car — since steam engines give off only one percent of the pollution generated by internal combustion engines.

Mention "steam car" and the mind reels with images of clanking, puffing monsters with huge boilers, mysterious pipes and hissing valves. But remember that of the 4,192 cars built in the US in 1900, 1,681 were powered by steam, 1,575 by electricity and only 900-odd by gasoline. Remember also that in 1906, a Stanley Steamer set a world speed record of 127.66 mph.

Remember, above all, that Bill Lear has designed and built some of the most sophisticated electronic equipment of our time.

Within months of getting started, he and his engineers came up with a revolutionary "Delta" steam engine with six cylinders containing 12 pistons driving three crankshafts arranged in a triangle. It was installed in a wedge-shaped racing car that Lear proposed to enter in the 1969 Indianapolis 500. The completed machine so impressed Jackie Stewart, the world's top Grand Prix driver, that he agreed to drive it at Indy.

"They call Bill Lear 'Merlin the Magician'," Stewart told me in Toronto last fall, "but he's a damned clever magician and if anyone can pull it off he can."

However, the Indy authorities, badly scared a couple of years ago by the turbo-car, laid down conditions that Lear refused to accept and his steam-car didn't enter. In the event, also, he became disillusioned with the engine.

Says Hugh Carson, Lear's chief engineer: "It proved too complex and although it had a good power-to-weight-to-volume ratio it was an awkward shape—too bulky. But we learned a lot from it."

The experience might have stopped a lesser gambler than Bill Lear in his tracks. But as one of his staff puts it: "He tells us, 'I want failures — but I want them fast.' He knows that failures are the technique by which you arrive at decisions."

The decision Lear arrived at was to press on with two current projects: converting a Dodge Polara to steam for road trials by the California highway patrol, and fitting a larger steam engine in a bus for similar trial use in California.

In the case of the car, Lear is using a regular gasoline engine block but fitting it with a boiler, condenser and the other accoutrements of a steam engine. The eventual results will have no resemblance to the old Puffing Billy type of steam engine.

The boiler, for instance, will consist of 900 feet of coiled tubing described by one writer as "not much bigger around than Raquel Welch". This has several advantages over the old cylindrical boiler — only about a quart of water will be required; it will be constantly condensed and recirculated, eliminating the need for frequent topping-up; and if any rupture were to occur in the system the result would be merely a thin jet of steam rather than a scalding cloud of it.

To boil the water, Lear says, you can use "any fuel from kerosene to camel dung".

Says Carson: "With steam, we will get 435 hp from a six-cylinder gas engine normally rated at 145 hp."

Despite this optimism, Lear is gradually cooling off on steam as a ready alternative to the internal combustion engine in ordinary cars. "It's too complicated for mass production," he says. "And you have to have equivalent cost, reliability, weight and horsepower. If you require a motor under 100 hp, it's OK. And it's perfect for buses and trucks, where you can have a heavier motor and you have room for the condenser and the other equipment."

And so, while he is going full steam ahead on the bus project, his current enthusiasm for cars is the gas turbine engine, as used in jet planes, including his own.

"Steam and gas turbines are about equal as far as turning off pollution is concerned," he says.

His staff of 150 is now building 70 gas turbines for experimental purposes. He proposes to get round one of the chief problems with the gas turbine as an auto engine — its low efficiency and high fuel consumption at low power levels — by running the turbine constantly at its most efficient speed and having it drive an electrical alternator which will store the power produced and deliver it as required to four electric motors, one on each wheel of the car.

"I can't tell you at this stage whether steam or the gas turbine will win out," Lear said. "But we're sure gonna be ready in either case. We're going down both paths very diligently."

So what are the main problems still to be solved?

"With steam, at least for trucks and buses, I really don't see any," he said. "We think we know all the answers. We know how to make the boiler, we've developed a control system and solved the combustion problem. It's just a case of putting it all together and we'll have a motor running for ourselves in three months.

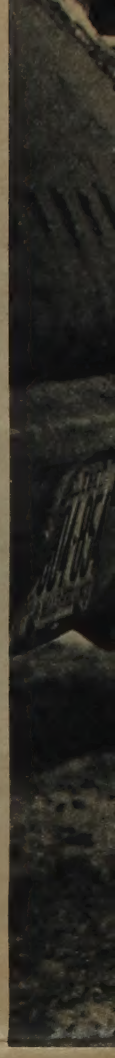
"As for the gas turbine, we've had some of the best engineers in the country look at my solution and they say it's bound to work. We're about seven months away from licking it. In either case, I think electricity will be the way to connect the power source to the wheels."

We were nearing Seattle now and as Lear prepared to resume his seat at the controls for landing, he permitted himself some reminiscences. "I started out to build a steam car," he said, "because I had nothing better to do. All of a sudden I found out I was regarded as the saviour of the atmosphere.

"When somebody blows you up like that it gives you added responsibility, so now I've got to do it, goddammit. But I've never had so much fun with my clothes on, I'll tell you that."

Later, addressing his meeting, he told a group of Seattle citizens trying to combat air pollution by pressing for an efficient mass-transit system: "Someone said the other day that Bill Lear doesn't know all the answers. OK. But he sure knows the questions."

And he said it with a lifelong confidence, born of what businessmen call his "good track record", that once Bill Lear knows the question, he can always find the answer.



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A Yellow Shroud For Montreal

Auto pollution is everywhere, although it is most noticeable in Canada's biggest city. But, with one exception, the provincial governments are doing nothing to remedy the situation

measured pollution levels, issued the chilling report that growing carbon monoxide pollution in Montreal was slowly damaging people's sight, their hearing, and even their brain cells.

While there are invariably many different sources of air pollution, one major culprit was clearly pinpointed — the motor vehicle.

Ethyl Corporation estimates that motor vehicle emissions contribute 77 percent of the carbon monoxide, 53 percent of the unburned hydrocarbons, and 41 percent of the oxides of nitrogen, to the total air pollution situation. Yet John Jefferies, of the air management branch of Ontario's department of energy and resources, puts the carbon monoxide figure from motor vehicles as high as 90 percent in many cases.

Montreal's conditions dramatize the situation facing all Canadian cities where carbon monoxide levels are higher than in many large US cities, and climb as the number of cars increases. In the past 12 years the cars in Montreal have doubled in number, and the density of cars per square mile — 5,130 — is greater than the level in New York City during 1964, when figures were last taken.

The health department report pointed out that at one two-hour period in the downtown area in December, 1968, carbon monoxide averaged 29 parts per million, well over the "safe limit" of 20 ppm advocated by many states in the US.

Knowledge of the problem of pollution isn't new. Yet, in all but one province, we still treat the atmosphere as if it were a sewer. There are still no national clean air standards.

All of which brings us back to the problem we have had all along — how to improve the internal combustion engine so it dumps fewer dangerous wastes into the air we breathe.

There are actually three different sources in the motor vehicle which produce air pollution — the exhaust system, the crankcase, and losses due to evaporation.

Most easily cured are crankcase emissions which occur when unburnt gases escape into the crankcase and mix with vapors from hot lubricating oil. But by feeding them back to the engine where they are burned they can be eliminated. This is a simple operation, involving valves costing a couple of dollars each, which are now being put on most new cars.

Gasoline which evaporates through the fuel tank breather tube or the carburetor, can be reduced significantly by using an activated charcoal filter which stops this leakage, according to a team of Toronto experts.

This leaves pollutants caused by incomplete burning of the fuel. Most fuel used in cars and trucks could be converted into harmless water vapor and carbon dioxide, if burnt in the presence of sufficient oxygen. Yet the internal combustion engine has an uncanny way of rarely getting the right amount of oxygen into the combustion process at the right time.

Result? The combustion of the fuel is incomplete, and some of the carbon in the fuel is oxidized to carbon monoxide. As well, other harmful fumes are produced.

This can be partly overcome by preheating the fuel mixture to ensure vaporization, or by replacing a standard carburetor with a fuel injection system which sends accurate quantities of fuel into each combustion chamber during each combustion stroke.

There are also methods for controlling combustion, for a second combustion or "afterburning" to get rid of most unburnt gases, and for filtering out toxic gases in the muffler.

But these methods will only be used if there are clearly enforced government regulations which limit the amount of exhaust a motor vehicle can spew into the air.

California was one of the first areas in North America to come to grips with air pollution.

In 1965 it set up regulations specifying how much exhaust would be allowed from a motor vehicle, and these rules have been in force on all vehicles built since then.

The following year, the United States government took the California regulations and made them law for the whole country.

The same needs exist in Canada. In fact, Canadian standards are especially vital because weather conditions can take our air pollution and hand it back to us in the form of highly unhealthy smog. This is especially so in the heavy, wet weather of

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Mr. Grafftey, former Conservative MP for Brome-Missisquoi, Que., is Canada's answer to Ralph Nader.

Until scientists give us an alternative, all governments must set and enforce laws limiting car exhausts

late fall, winter, and early spring. Then the poison in the air over our cities becomes trapped in an umbrella. The wintertime air rises—filled with pollutants — but it stops at low levels because there are virtually no wind or convection currents to carry it away. This limits the volume of air in which diffusion of pollution can take place. Against this "lid", the dirty air stops, usually from 200 to 800 feet up, and sometimes inverts and comes right back to ground level.

The Ontario government started action two years ago, by adopting the American exhaust regulations which Washington had implemented the year before. They came into effect on all 1969 models as they came onto the market in the fall of 1968.

Jefferies says positive effects have been achieved by the regulations.

"A controlled car which meets the 1969 Ontario regulations emits 50 percent less pollutants than an identical uncontrolled car." For 1970 models, he adds, there is again a 40 percent reduction on the 1969 figures, meaning that a 1970 car has about 30 percent of the polluting emissions that a totally uncontrolled car does.

The reason things are getting better each year is simply that the regulations get increasingly more strict in specifying how much exhaust will be allowed. Then in building their vehicles for the following year, the automotive industry must comply with the more stringent standards.

Recently, in response to growing public awareness of the pollution caused by motor vehicles, Henry Ford III announced that the Ford Motor Co. would spend $31 million in 1970 to combat air pollution from car exhausts and $30 million on control of air pollution from its plants.

Each year, government agencies, such as Ontario's automotive emission control, test several new cars of every model to ensure that they don't exceed the exhaust level specified. If the standards are met, the industry is given the green light.

To counter any effort on the part of the auto industry to put its best foot forward when it presents new models for exhaust inspection, these agencies continually perform spot checks on new models. For instance, Ontario now operates two mobile vans for these inspections, and often makes tests at the same time as the department of transport inspectors conduct their series of tests for auto safety.

Considering that in most Canadian cities something over 50 percent of air pollution is due to traffic, these efforts can only bring cheers from all air breathers, provided they are lucky enough to be living in jurisdictions where the regulations are in force. That means, so far, only residents of Ontario can applaud.

The approach is clear:

Until technology delivers to us a practical alternative to the internal combustion engine, governments must set and enforce regulations to limit the exhaust from motor vehicles.

By making the regulations stricter each year, there is also a built-in guarantee that the problem will remain in manageable proportions as our population increases.

This logic appears to have finally brought us to the verge of national standards.

At the November federal-provincial health ministers' conference, agreement was reached between federal Health Minister John Munro and his provincial counterparts for the federal development of national clean air standards.

Munro believes the standards can be developed within a year, and that they will lead to a Clean Air Act under which air polluters could be prosecuted.

Details so far remain vague, yet it is likely these standards will encompass motor vehicle exhaust. For the moment, however, they don't exist.

Even a province which has standards can't guarantee that its dirty neighbors, driving their unregulated vehicles, aren't going to come over the border and through the province, leaving an unwelcome calling card.

But for the moment we still hear statements such as that given in 1968 in Toronto by an executive in the auto industry, which illustrates that we cannot rely on others' standards, but must have our own enforceable national code. The executive told a reporter that, in most cases, anti-pollution equipment mandated in the US but not required by Canadian law, would be sold as an "extra-cost option".

A recent article in London's Sunday Times talked about technological and scientific advances, and suggested that we shall probably have cleaned up the air by the year 2000.

It won't come about, however, by accident or by wishful thinking. We have a national problem; we need a national code; it's time for Ottawa to act.◁